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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/512,336	02/24/2000	Seiichi Fukuda	SON-1745	5387

7590 12/31/2001

Ronald P Kananen
Rader Fishman & Grauer
The Lion Building
1233 20th Street N W Suite 501
Washington, DC 20036

EXAMINER

CHEN, KIN CHAN

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 12/31/2001

67
61

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/512,336

Applicant(s)

FUKUDA, SEIICHI

Examiner

Kin-Chan Chen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on _____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ha et al. (US 6,146,542) in view of Davis et al. (US 5,164,330).

In a dry etching method, Ha teaches that tungsten may be dry etched with mixed gas containing fluorine gas, chlorine or hydrogen bromide, oxygen and nitrogen (col. 3, lines 34-65).

Ha does not explicitly state that the gas containing fluorine gas may include a compound having fluorine and carbon in a molecule. In a method of etching a tungsten layer, Davis discloses that it is well known that tungsten and refractory metals may be etched by etchants gases containing CF₄, CF₃Cl, and CF₂Cl₂ (col. 2, lines 40-41). Davis also teaches that tungsten etch may incorporate etchants such as CF₄, CF₂Cl₂, or similar etchants with NF₃ -Ar to optimize etch rate and uniformity (see abstract, last 5 lines). Hence, it would have been obvious to one with ordinary skill in the art to modify Ha by incorporating CF₄, CF₂Cl₂, or similar etchants as disclosed by Davis, in order to optimize etch rate and improve uniformity.

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3. Claims 4-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ha and Davis as applied to claims 1-3 above, and further in view of Yan et al. (US 6,296,780 B1).

The discussion of the combined references of Ha and Davis from above is repeated here.

In a method of fabricating a semiconductor device, Ha teaches laminating upwards a polycrystal silicon film or an amorphous silicon film, a tungsten nitride film or a titanium nitride film and a tungsten film on a silicon substrate (Col.3, lines 30-39). The tungsten nitride or the titanium nitride and the tungsten film may be dry etched with mixed gas containing fluorine-containing gas and chlorine or hydrogen bromide, oxygen and nitrogen (col. 3, lines 40-64; col.4, lines 1-3).

Ha does not explicitly state that for etching titanium nitride film, the gas containing fluorine gas may include a compound having fluorine and carbon in a molecule. In a method for etching titanium nitride film, Yan teaches using a gas comprising fluorine-containing gas that includes a compound having fluorine and carbon in a molecule (col. 4, lines 6-22). Hence, it would have been obvious to one with ordinary skill in the art to use the compound having fluorine and carbon in a molecule as taught by Yan in the composition of the etchant of modified Ha and Davis for etching titanium nitride film and tungsten film in order to reach effective etching and has good CD-control.

Ha is not particular about the semiconductor device being fabricated in the dry etching method, therefore, a conventional feature of a semiconductor device such as

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gate electrode may be formed using a mask of silicon oxide or silicon nitride because it is conventional in the art of semiconductor device fabrication. It is noted that applicant did not traverse the aforementioned conventionality of features, which have been stated in the office action in Paper No. 4.

As to claim 5, Ha teaches that the polycrystal silicon film or the amorphous silicon film may be etched with gas, which does not contain fluorine (col.4, lines 25-26).

Response to Arguments

4. Applicant's arguments filed on August 20, 2001 have been fully considered but they are not persuasive.

In response to applicant's argument that Davis teaches away from using fluorocarbon compounds due to their tendency to cause carbon contamination, in fact, Davis teaches a preferred, a better, or another way that will reduce carbon contamination. However, the existing, old way is still well known.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kin-Chan Chen whose telephone number is (703) 305-0222. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703)

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305-5408 for regular communications and (703) 872-9311 for After Final communications. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-2934.

K-C C
December 27, 2001

Kin - Chen CHEN

Patent Examiner
Group Art Unit 1765